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# Treatment of the Fractures of the Calcaneus Involving the Subtalar Joint

by

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As to the involvement of the lower extremities, we must always take into consideration the effect of weight-bearing. Such is the same with fractures of the calcaneus. In some cases well chosen, it might be possible to replace the fragments remodelling the articular surfaces without fusion. The incongruity of the articular surfaces, however, would persist, if the cartilage layers are more or less damaged. It produces by weight-bearing the stimuli which will bring forth the posttraumatic arthritis and further the osteoarthritic changes in the subtalar joint. Then the major disturbances of the disorder appear, that is, the painful stiffness and swelling of the foot. It would be meaningless, on the other hand, to remodel the articular surfaces without fusion if the stiffness persist in the subtalar joint after the surgery. The procedure of the subtalar arthrodesis eliminates or at least decreases the persistent and disagreeable arthritis. This advantage appears to outweigh the disadvantage of the limited inversion and eversion of the hind part of the foot. Thus the open reduction and subtalar arthrodesis were almost routinely carried out in the fractures of the calcaneus with the severely involved subtalar joint in our clinic.

The disturbances after the subtalar arthrodesis were not so discouraging as had been previously suspected by surgeons. The patients went back to their previous work with no less ability,<sup>1) 2) 4) 5)</sup> which were so in our experience. Therefore, the purpose of the article consists in the exploration of disturbances after the subtalar arthrodesis and in the reflexion, based upon the findings, of our clinical experiences. The disturbances, which one might also call the minor disturbances after the subtalar arthrodesis, had been masked by the major disturbances and pushed away into the background before the usual adoption of the subtalar arthrodesis in the treatment of the disorder.

## TREATMENT

With a patient in a prone position, a lateral incision is laid down just on the talocalcaneal joint fissure and the subcutaneous fibrous and fatty tissues are cut off sharply without undermining in order to avoid superfluous damages to them. The retinaculum mm. peroneorum inferius opened, the long and short peroneal muscle tendons are divided in Z-shape or retracted away intact. The capsule is cut off and the cavity of the talocalcaneal joint is opened. With the section of the ligamenta talocalcanea, a sufficient view of the joint cavity is obtained. The cartilage layers are excised from the three joints between the talus and calcaneus. Then the displaced posterior part of the calcaneus is drawn downwards by means of the posteriorly inserted Steinmann's pin to the calcaneus<sup>8)</sup>

and impacted articular surfaces are elevated under the control of direct vision. Then a lateral expansion is corrected with Boehler's clamp. At that time, some valgity of the calcaneus must be attained. After the exstirpation of residual cartilage layers, two Kirschner wires are inserted for the purpose of the maintenance of reduction, one wire pointing from the inner side of the Achilles tendon through the hind part of the talus to the anterior part of the calcaneus and the other one from the lateral side of the tuber calcanei to the neck of the talus. After the closure of the capsule, the long and short peroneal muscle tendons must be closed within the retinaculum and neighbouring tissues in order to prevent a lengthy wound healing. The skin is to be closed not so much tightly that the tension may be averaged throughout upon the sutured skin for the prevention of ulcer formation.

Postoperative management : After the surgery, the affected foot is immobilised in a plaster cast from middle part of the thigh to the toes with the knee in ca.  $160^{\circ}$  flexed position and the foot in slight equinus. It is elevated. One week later, the plaster cast is cut off and a plaster splint is applied. After the wound healing, that is, usually two weeks after the surgery, a warm bath is prescribed for the purpose of the resumption of disturbed local circulation of the affected foot. And the plaster splint from the leg to the toes is applied. Then the patient is encouraged to move actively without weight-bearing the toes, ankle joint and knee several times a day. Usually four weeks after the surgery, the Kirschner wires are withdrawn. If the calcaneus is consolidated without bone atrophy, a plaster cast of shoe form is applied to the foot and the patient is allowed to walk. Thereafter the plaster cast is exchanged with a metallic foot plate and the patient is put under the monthly observation until the return to his previous work.

#### MATERIALS AND RESULTS

The fractures of the calcaneus involving the subtalar joint in our clinic from 1957 to 1965 were of twenty-one calcanei of eighteen patients, of which sixteen patients were male and two female. A radiological examination revealed in a calcaneus of a patient the fracture with displacement of the lateral part of the subtalar joint and in the others the fracture with central crushing of the whole subtalar joint according to the classification presented by WATSON JONES<sup>7)</sup>. In the former case, surgical reduction was performed without subtalar arthrodesis. In the latter cases, both the surgical reduction and subtalar arthrodesis were carried out at a single operation but one case was exceptionally excluded in which the immobilisation was prescribed owing to an infectious complication after open fracture.

The patient of the youngest age was eleven years old and that of the oldest seventy-two years old. The age distribution was widespread with a preponderance of the generations of social activity. Other details of the information were not obtained because of a small series of our cases. Three patients were bilaterally affected. Of unilaterally affected fifteen cases, nine were right-sided and six left-sided. The injuries were in all cases due to a direct violence (fifteen patients, falls from a height; two, traffic accident; one, collision of other thing to the foot).

Of fourteen cases, the period of protection with plaster cast and splint is less than two months in one case, from two to three months in nine cases, from three to four

months in three cases and more than four months in one case. The interval between the surgery and review was less than one year in nine cases, from one to three years in two cases and more than five years in five cases.

It is said that a normal healing does not exist in the compressed fractures of the calcaneus and that the prognosis is fair to good in most cases. Results are called good when a foot is painless and useful unless excessive work is demanded of it, while results are called fair in those patients able to their former occupation with some disability which is alleviated by pads or plates worn inside the shoe, earning capacity but slightly impaired. Results are called bad when there is marked disability and greatly lessened earning power.<sup>6)</sup> According to these criteria, good results were obtained in six cases of which two (case 2 and 3) were, as one might say, excellent in their results because of no disturbances even after excessive work in our series of cases followed-up more than one year after the surgery, although accompanied by the inevitable handicap of the limited inversion and eversion of the hind part of the foot. One case was fair in its result (case 4).

#### CASE REPORTS

Case 1. A man aged thirty-five with fracture of both calcanei. Operated upon one week after injury. At the review one year and three months after the surgery, neither stiffness nor swelling was observed. No immediate discomfort by and after gait. But after the work of a day the pain of slight degree was sometimes felt in the left foot.

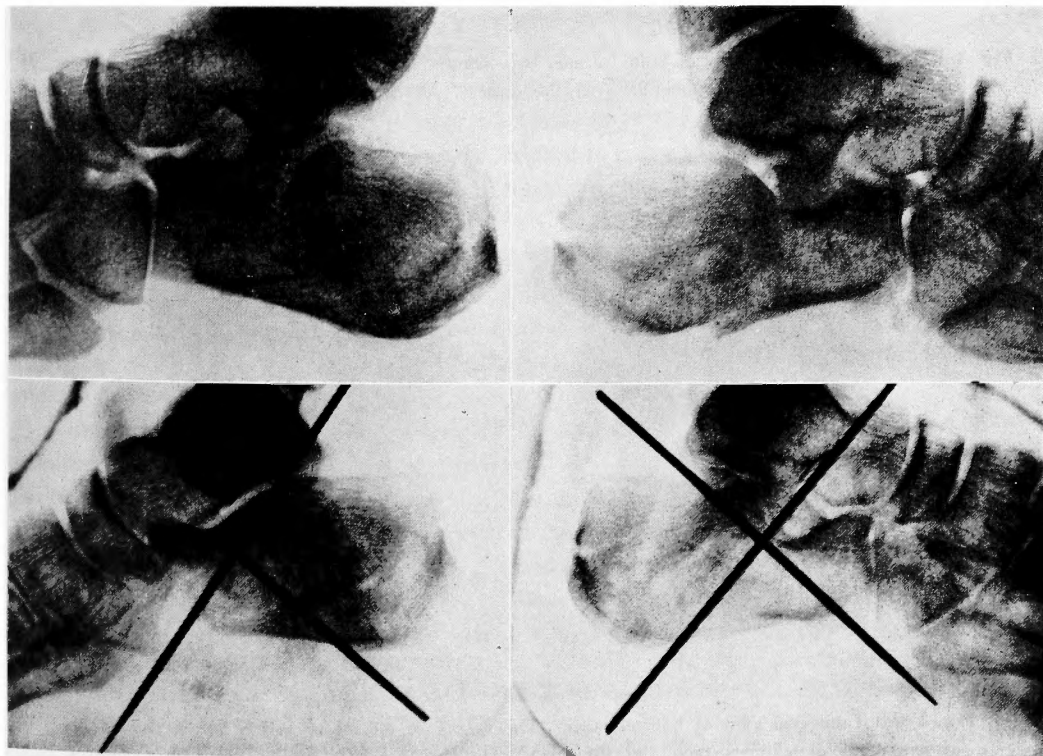
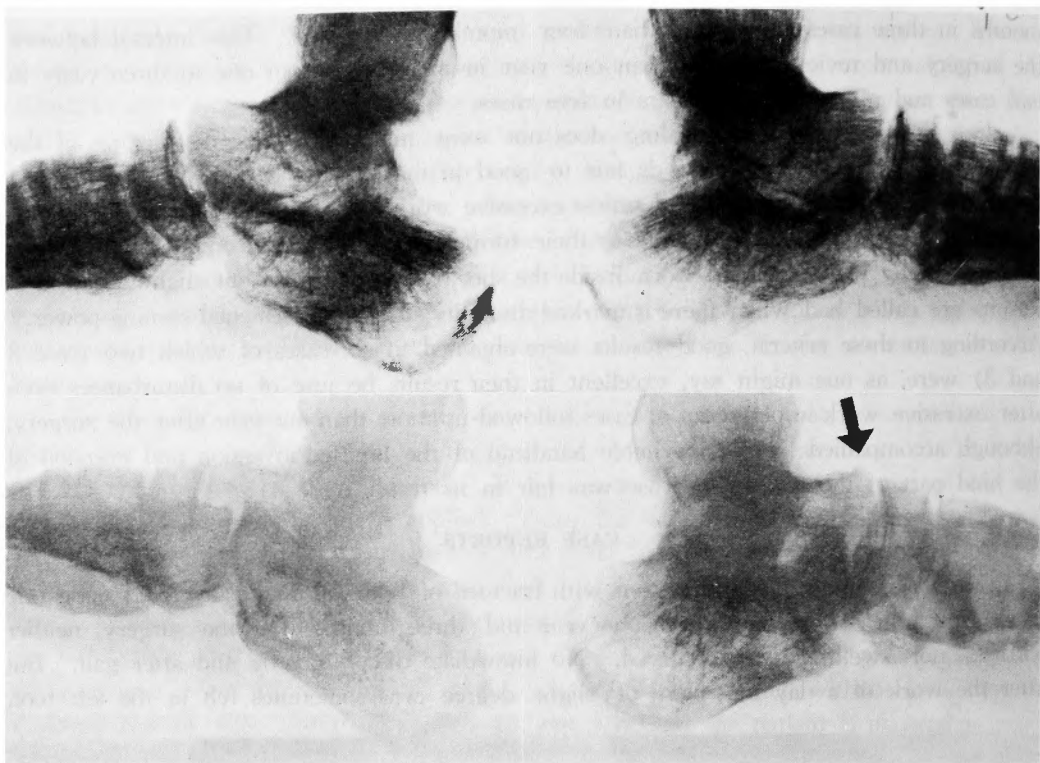
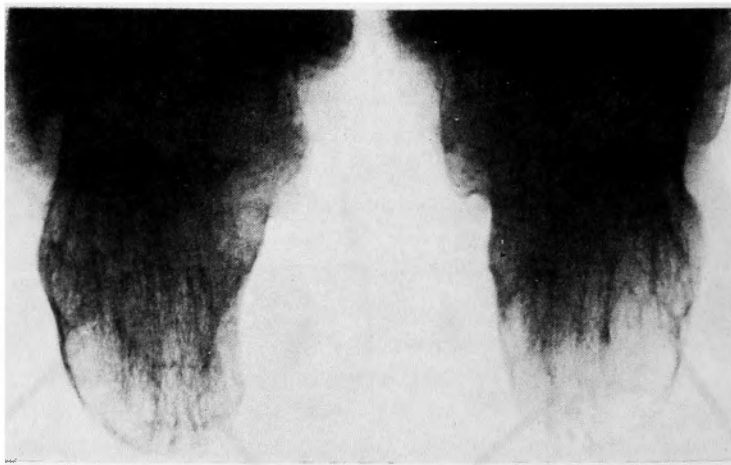


Fig. 1-A. Case 1. Roentgenograms of both calcanei before and after surgery.



**Fig. 1-B.** Above : Lateral view of both calcanei two months after the surgery. Below : Lateral view of both calcanei one year and three months after the surgery. An arrow shows a small spur formation in the head of the talus.



**Fig. 1-C.** Tangential view of both calcanei. The valgus of the calcaneus was decreased with the patient in the standing position (see the text). The curved axis of the left calcaneus suggests a failure of reduction.

The valgity of the calcaneus was decreased in the left side. A radiological examination revealed a small spur formation at the head of the talus (Fig. 1-A, B, C).

In the normal foot viewed posteriorly in the standing position, the heel axis is of a slight valgity in comparison with the leg axis. We call in the article this appearance the valgity of the calcaneus. Even if it is decreased, the calcaneus is not in a varus position after reduction. So the change is termed the decreased valgity of the calcaneus.

Case 2. A man aged forty-three with fracture of the right calcaneus. Operated upon nine days after injury. At the review eight years after the surgery, the patient complained no discomforts. No stiffness and swelling even after excessive weight-bearing. But sitting on the floor in Japanese mode is of a little difficulty. The valgity of the calcaneus was normal in the standing position (Fig. 2).

Case 3. A man aged fifty-two with fracture of the left calcaneus. Operated upon one week after injury. At the review seven years after the surgery, neither pain nor swelling occurred even after the weight-bearing of long duration. The valgity of the calcaneus was normal. The only inconvenience was the limited inversion and eversion of the hind part of the foot.

Case 4. A man aged fifty-three with fracture of the left calcaneus. Operated upon one month after injury. At the review seven years after the surgery, swelling of slight degree was observed in the lateral aspect of the foot and ankle joint. After moderate weight-bearing occurred pain and swelling in the foot which would be lessened by taking a hot bath without any medicaments. Normal pattern of gait on the flat floor and staircase. A slight weakness of muscle strength was checked by standing on toes test. The valgity of the left calcaneus was apparently decreased.

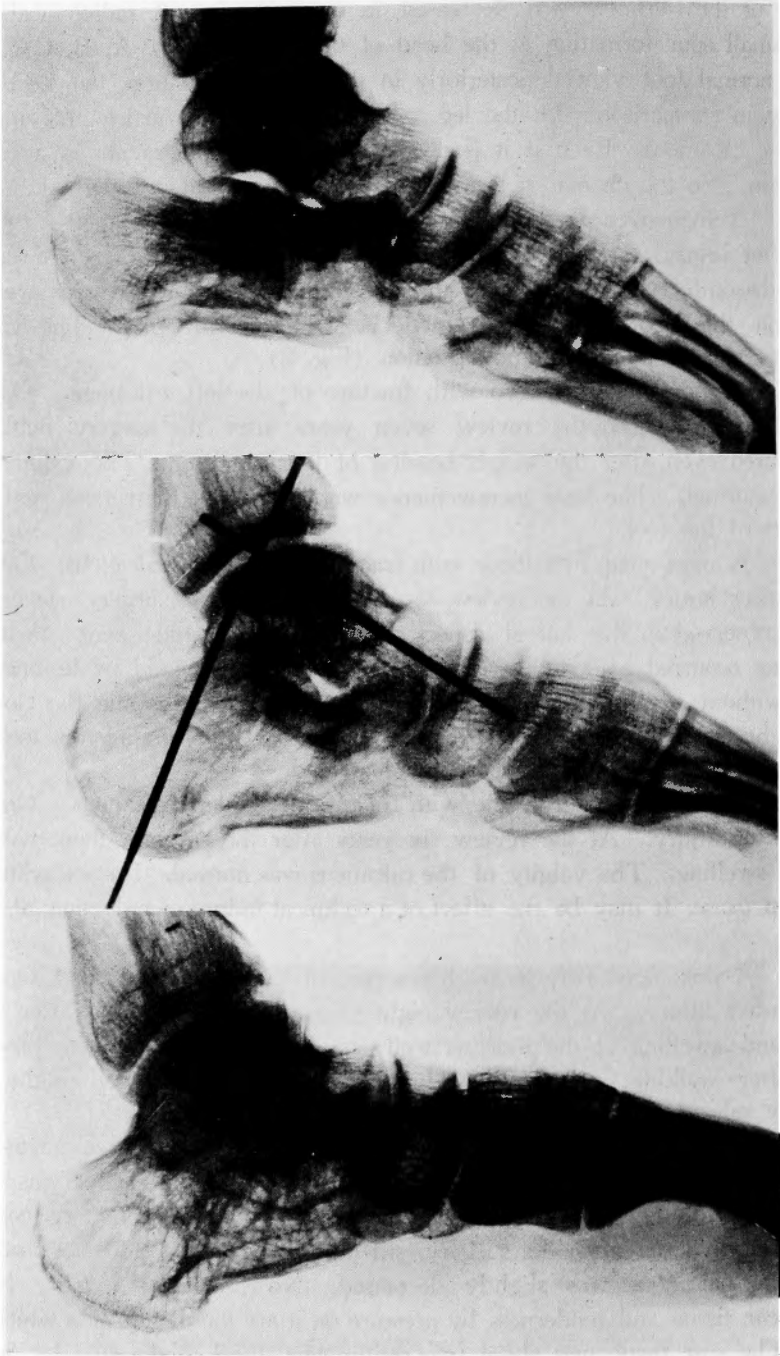
Case 5. A man aged thirty-nine with fracture of the left calcaneus. Operated upon two weeks after injury. At the review six years after the surgery, there were not pain, stiffness and swelling. The valgity of the calcaneus was normal. Pes excavatus developed from unknown cause. It may be the effect of a technical failure of reduction at the surgery (Fig. 3).

Case 6. A man aged fifty-six with fracture of the right calcaneus. Operated upon eleven days after injury. At the review eight years and three months after the surgery, no stiffness and swelling of the foot as well as of the ankle joint were observed. But sometimes after walking, pain and swelling of slight degree occurred in the foot. The valgity of the calcaneus was decreased.

Case 7. A man aged sixty-seven with fracture of the right calcaneus. Operated upon three weeks after injury. Ten months after the surgery, the foot was still swollen and tendovaginitis of the peroneal muscles was treated with the injection of corticosteroids. At the review two years after the surgery, stiffness and swelling were not observed. The valgity of the calcaneus was slightly decreased. No discomfort at gait. Hypaesthesia around the scar tissue and tenderness by pressure on it are the discomforts which aggravate in winter. The scar tissue was about two centimeters distal to the subtalar joint.

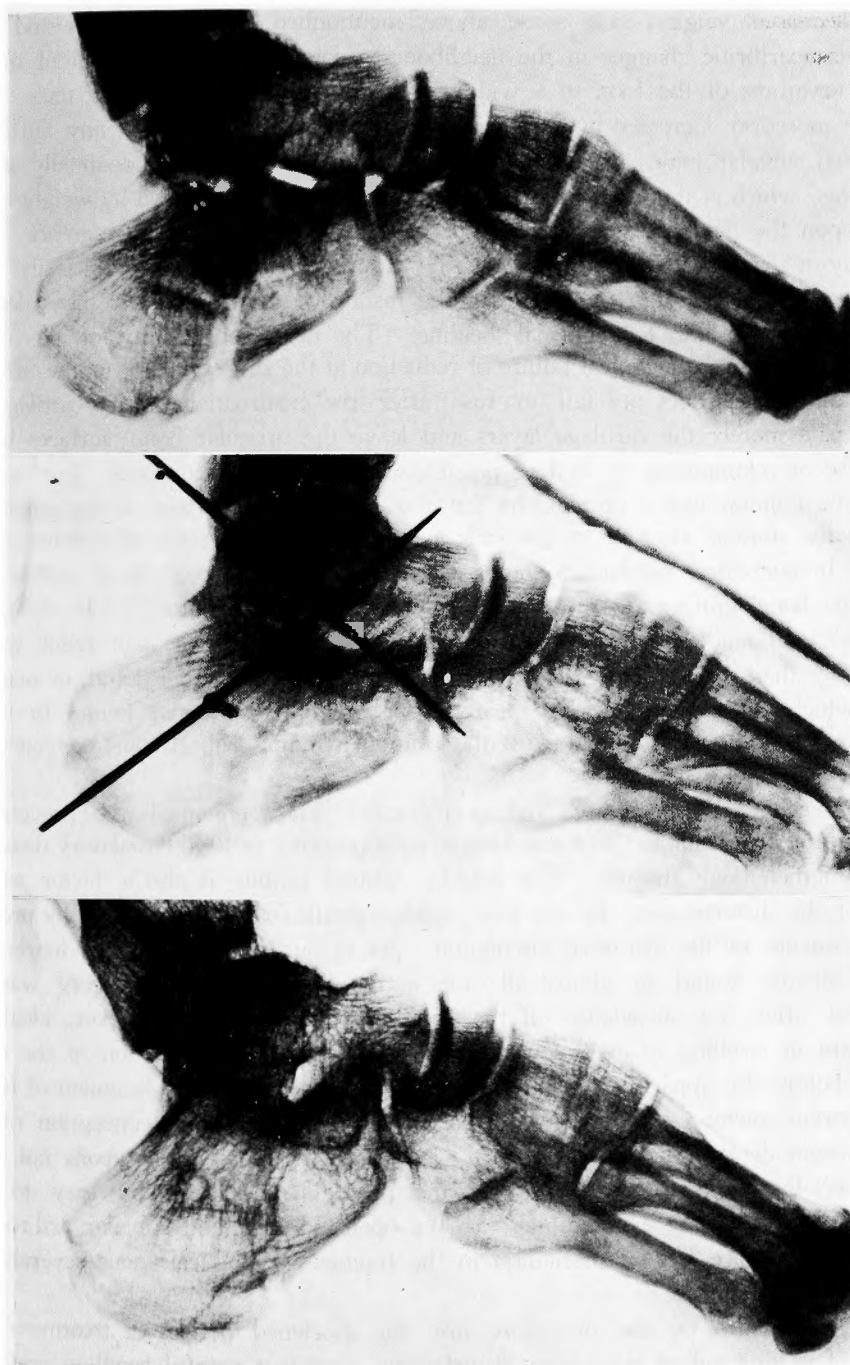
#### COMMENTS

The main pathological changes after the open reduction and subtalar arthrodesis are first of all the swelling and pain of slight degree after weight-bearing. In those feet was



**Fig. 2.** Case 2. Lateral roentgenograms of the right foot. Above: after injury. Middle: after surgery. Below: eight years after the surgery. The foot is compatible with excessive work.





**Fig. 3.** Case 5. Above : after injury. At the surgery the posterior articular surface was comminuted and displaced. Middle : after the surgery. Below : at the review six years after the surgery, pes excavatus developed from unknown cause but perhaps owing to a technical failure of reduction at the surgery. The foot was, however, compatible with excessive work.



found a decreased valgity, in a sense above mentionned, of the calcaneus and in some cases the osteoarthritic changes in the neighbouring joints. The involvement of the physiological curvatures of the foot, in a wide sense, may be responsible for these changes, which are moreover increased by the weight-bearing to the foot without any buffer action of the fused subtalar joint. In other words, those are the changes undoubtedly secondary to the stress, which is abnormal in its direction and quantity (reinforced by weight-bearing), imposed upon the neighbouring joints and periarticular tissues. But the reference in details of the abnormal curvatures of the foot to the disorders after the surgery is the problem hereafter to be solved. On the contrary the results of the cases with the calcaneus of normal valgity are akin to a normal healing. The decreased valgity of the calcaneus seems to be due to the technical failure of reduction at the surgery. As to the arthrodesis, the articular surfaces does not fail to fuse after the exstirpation of the cartilage layers. We exstirpate merely the cartilage layers and leave the articular bone surfaces intact for the purpose of maintaining as well as possible the height of the calcaneus. For we utterly agree to the opinion that a prerequisite for a well functioning foot is the restoration of an essentially normal contour to the arch and heel and restoration of normal malleolar height<sup>4)</sup>. In our cases, we had no necessity of bone grafts, though some authors recommended the bone grafts into the defect of the replaced calcaneus<sup>3)5)</sup>. In the case 7, a hypaesthesia and tenderness by pressure persist in the region of the scar tissue which lies more distally than usual. No disturbances were found, on the other hand, in many other cases of which the scar tissue was near the fissure of the subtalar joint. In any case, the intervention must be minimal with the caution avoiding superfluous damages both to the soft tissues and bones.

The keystone of preoperative and postoperative managements is the prevention and skillful control of swelling. The swelling is an appearance of local circulatory disturbances, which strengthen bone atrophy. The lengthy wound healing is also a factor as well as a result of the disturbances. In one case, tendovaginitis followed bone atrophy presumably as a consequence of the disturbed circulation. As to our series of cases, a marked swelling was already found in almost all cases at the first seen. The surgery was usually carried out after the subsidence of the swelling. It would be, however, ideal for the management of swelling to operate upon or at least to obtain the reduction of the displaced calcaneus before the apparition of traumatic swelling, because the displacement of fragments is an important factor of swelling. We are of impression that the conception of the arthrodesis could depress, in a psychological view-point, the mood of surgeons not so much trained specially in the foot surgery. But the procedure is simple and easy to be performed. The results are encouraging. So the open reduction and subtalar arthrodesis are the method of choice without hesitation in the fractures of the calcaneus severely involving the subtalar joint.

The advantages of the procedure are the shortened period of treatment and the certainty of getting rid of the major disturbances, persistent painful swelling and stiffness of the foot.

## SUMMARY

A small series of fractures of the calcaneus in our clinic was reviewed and the surgical procedure of our choice is shown. The advantages of the subtalar arthrodesis are reconfirmed. They are the shortened period of treatment and the certainty of obtaining the results compatible with vigorous work. Pain and swelling of slight degree develop with weight-bearing in the affected foot of some cases after the subtalar arthrodesis. In these cases the valgity of the calcaneus was decreased. These disturbances after the surgery are presumably due to abnormal curvatures of the foot. The keystone of preoperative and postoperative managements is the prevention and skillful control of swelling of the foot.

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## 和文抄録

## 距骨下関節の損傷を伴う踵骨々折の治療について

和歌山日赤整形外科

森 田 信・小 田 一

距骨下関節面の損傷を伴う踵骨々折に対し、我々が通常行なっている手術方法（観血的整復術並びに一次的距骨下関節固定術）を述べた。更に16例18踵骨の治療経験並びに7例の長期観察例に基づき術後足部に現われる障害を検討した。術後障害の主たるものは体重負荷後足部に生ずる軽度の疼痛及び腫脹であり、この様な障害を伴う症例では、立位で後方より見た際、踵骨軸の Valgity が減少していた。これは踵骨自体の整復不十分が原因となり、体重負荷に際し、足部の関節及び関節周囲組織に過重が加わるため生ずると考えられる。これに対し、術後立位に於いて踵骨の Valgity が正常な症例では過度な労働の後でも足部に障害は全

然生じなかつた。その他整復不十分により凹足変形が出現した症例もあつた。しかし骨移植を行わず単に関節の軟骨層を切除する操作で関節癒合術に失敗した症例はなかつた。術後軟部組織に残る障害は手術時の注意及び配慮により予防出来よう。

十分に踵骨を整復し同時に距骨下関節固定術を併用すれば治療期間を短縮させ、骨折後の頑固な疼痛及び腫脹を確実に除去し得るというこの術式の長所は踵骨の内外旋運動の制限という欠点を補つて余りあるものと考えられる。尚術前及び術後には腫脹に対する合理的な予防及び処置が肝要である。